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(54) Modular optical fiber core tape, separable into a plurality of tape units or modules, method of manufacturing such tape and optical cable using the same.

(57) The tape of the present invention has at least one wireshaped, high tensile strength separation element embedded into the coating resin introduced in line, at the longitudinal section between contiguous optical fibre filaments and designed to easy the manual split of the tape into tape units each comprising, in particular, four fibres without any special tool.

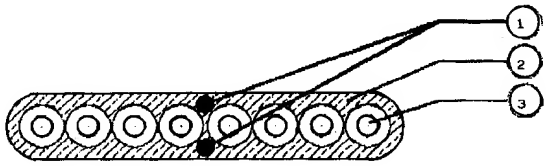

Fig. 1

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The present invention relates to a modular optical fibre core tape, separable into a plurality of tape units or modules, to a method of manufacturing such tape and to an optical cable using the same.

Small-sized optical cables are nowadays available on the market, comprising inside them tapes formed by four optical fibres aligned and embedded into a common coating generally made of acrylate resins, of the same nature as the primary coating of the optical fibres.

Large-sized cables (typically 200-1000 optical fibres) are also available, using ribbons or modules of 8, 12, 16, ... optical fibres. In particular 8-fibre modules are used, in turn separable into two 4-fibre modules.

The need and utility of the separability is due to the compatibility of the 8-fibre tapes with the widely-circulated 4-fibre tapes with which they can therefore be promiscuously handled, fibre-to-fibre jointed through multiple or single melting or through multiple or single connectors.

In order to be able to easily split the tapes into 4-fibre modules on the field without damaging the optical fibres and without using special tools, several solutions have been adopted. One of these is based upon a double embedding, i.e. two 4-fibre modules are preliminarily assembled and cross-linked and subsequently a common coating is applied around the two flanked modules.

Clearly this solution, besides being expensive because of the double process, entails on increase in size and weight both of the tape and the cable employing it.

Other solutions are based upon the narrowing of the thickness of the covering resin at the portion of the split line between the two modules.

In one of them, such narrowing is obtained by covering the two optical fibres adjacent to the split line along a longitudinal cross-section of the tape with flexible resin having low Young's module and then embedding the whole into rigid resin having high Young's modules. In such way, at the split line, the thickness of the rigid resin coating becomes smaller. However, also this type of tape has the same drawbacks as the above-mentioned double process solution.

Another solution is based upon the application of a very thin layer of resin (typically 20 micron thick against 50-80 microns generally used) with the expedient of adding a release agent at the line between contiguous optical fibres when the tape is to be split in order to make the resin softer at the separation line during split.

Also this solution has drawbacks since, besides weakening the structure of the tape, the introduction of release agents may give rise to problems, especially in the presence of humidity. In fact, being the acrylate of the coating an hydrophilic material, the eventual absorption of water into the coating can entail the localization of the same in the discontinuity zone created by the releasing agent with bubble formation which could cause transmission losses due to microbendings of the optical fibres.

Moreover, tapes used nowadays still require to use a specific tool for cutting and/or eliminating flashes.

It is an object of the present invention to overcome the prior art drawbacks.

This and other objects which will become more apparent hereinafter, are achieved through a modular optical fibre core tape, separable into a plurality of tape units or modules and by a method of manufacturing the same, which are characterized in that at least one high tensile strength, thread-like separation element, made of a material chemically compatible with the covering resin is embedded, in-line, into the resin in correspondence with at least one longitudinal cross-section between contiguous optical fibres of two adjacent modules and subjected, still in-line, to a tensile stress under in-line control of the latter.

Further characteristics and advantages of the invention will result better from the following description of an embodiment thereof given by way of a not limiting example in conjunction with the attached drawing wherein

- Fig. 1 represents schematically a cross-section of an 8-fibre tape separable in accordance with the present invention, and
- Fig. 2 represents two modules, each incorporating four optical fibres, obtained by splitting the tape of Fig. 1

With reference to the figures, and in particular to Fig. 1, the tape is composed of a series (eight in the embodiment illustrated herein, separable into two 4-fibre modules) of optical fibres 3 disposed in a parallel arrangement on a plane, embedded into a protective coating matrix 2 generally made of acrylates of the same nature as the primary coating of the optical fibres.

As the split line of the modules (between the 4th and the 5th fibre in the illustrated embodiment), at least one (two in Fig. 1) separation element 1 made of a material chemically compatible with the acrylates of the matrix and having high tensile strength is embedded in the matrix 2.

In the illustrated embodiment, the two separation elements 1 are thread-like with a circular cross-section and are arranged symmetrically with respect to the plane formed by the axes of the optical fibres 3.

The separation element can be formed by wires made of polyamide resin or other synthetic materials, and therefore polyester or aramid fibre

yarns, fibre glass cords, carbon fibres or metallic wires could be used as well. At any rate the used wires should have a tensile strength preferably not less than 35 N/sq.mm.

Advantageously, the separation element can be suitably coloured in such a way as to give the matrix an orientation of the type, e.g., up-down to which reference is made in numbering the optical fibres which, therefore, can be embedded in the matrix without preventive coloration, or the element can be colorless if the optical fibres are already coloured, with the same result.

The optical fibre core tape is manufactured by suitably applying in line the eight fibres paralleled up and one or more (typically two) separation elements.

The manufacturing process, preferably but not exclusively, of the typic acrylate cross-linking through UV irradiation comprises the in-line control of the tensile stress of both the eight optical fibres and of the separation element(s) at the same time, preferably but not necessarily through electronic or electromechanical adjustment of the decoilers.

Therefore, it is necessary to use at least one decoiler for the separation elements, or to use wheels or continuous belts in line for detection and braking of the separation elements with control of the braking and therefore of the tensile stress, the braking force having such values as to allow tensile stresses on the separation elements preferably comprised between 5 cN and 50 cN.

The resin of the matrix is preferably, but not exclusively, applied by pressure through suitably calibrated dies, which also perform functions of aligning the tape structure and forming the profile of the same with the wished dimensions.

For instance, in a tape comprised of eight fibres already provided with suitable acrylate primary coating, each having outer diameter 245 + 10 microns and already coloured some microns thick using UV cross-linkable or thermally-dried inks, one or more wires 50 to 250 micron diameter can be used as separation element(s), depending on the needs of use.

The resin matrix is applied around the whole array composed of the eight optical fibres and separation elements according to the process described above; its function is to embed optical fibres and separation elements in a one piece (whose cross-section is shown in Fig. 1), said matrix being also a secondary coating for the embedded optical fibres, and a cabling base module in optical fibre cables generally, but not necessarily, large-sized cables.

Such tape has outer dimensions generally confined within:

* thickness : 380 microns plus 50 microns
* width : 2150 microns plus 200 microns

The split of the tape into 4-optical fibre modules is obtained manually in a simple manner by exerting a direct tensile force on the separation element(s) towards the outside of the tape while keeping the element, preferably but not necessarily, stretched perpendicularly to the fibre's axis and to the tape's surface.

Thus the invention fully achieves the above-mentioned object.

Through the structure and the method described above in accordance with the present invention there is provided a modular optical fibre core tape, in particular an 8-optical fibre tape, having limited dimensions, a compact structure unweakened at any point, quite the contrary strengthened, which fully surrounds the fibres and therefore in every circumstances it acts as an adherent secondary coating for the fibres.

Moreover, the tape according to the invention does not require the use of any special tool neither for splitting the modules (4,5) nor for the eventual cutting and/or elimination of flashes, since the split operation of the embedded separation element is clear-cut (Fig. 2) and accurate, i.e. it is as if the cutting tool were pre-introduced into the tape matrix.

A further intrinsic advantage of the tape in accordance with the invention, lies in the possibility of a different identification code for the optical fibres.

In fact nowadays it is customary to colour the fibres with differently coloured inks. The presence of the coloured separation element inside the tape matrix in accordance with the present invention makes this unnecessary with obvious cost savings and improved reliability of the product.

While the invention has been described with reference to a specific embodiment of an 8-optical fibre tape in order to show the implementation of the inventive concept, it should be noted that the invention is not to be construed as limited to the illustrated embodiment being susceptible to those modifications and variations which being apparent to those skilled in the art should be understood as falling within the above-mentioned inventive concept.

For instance, in order to further improve the split operation, one or more variations in the profile of the cross section, e.g. notches, can be provided at such extent, as to number and dimensions, that the structure of the tape is not weakened, as well as should the separation element not be pulled correctly, means could be provided for the purpose.

Naturally, the materials and the dimensions can be varied according to the needs of production and use still observing the characteristics illustrated,

described and hereinafter claimed.

Claims

1. Modular optical fibre care tape, separable into a plurality of tape units or modules, for use in optical cables, in particular large-sized cables, said tape including a modular series of optical fibres disposed in a parallel arrangement on a plane and embedded into a synthetic resin matrix, particularly of the same nature as the primary coating of the optical fibres, the split into modules being contemplated along at least one longitudinal section between contiguous fibres of consecutive modules, characterized in that, at least one separation element is embedded in said resin matrix at said at least one longitudinal section and designed to easy the splitting of the tape along said longitudinal section, said separation element being made of a material that is chemically compatible with the resin and of high tensile strength.

2. Optical fibre core tape according to claim 1, characterized in that said at least one separation element is thread-like and has a tensile strength preferably not less than 35 N/sq.mm.

3. Optical fibre core tape according to claim 2, characterized in that said at least one thread-like element has its outer diameter preferably comprised between 50 and 250 microns.

4. Optical fibre core tape according to anyone of preceding claims, characterized in that said at least one separation element is coloured and said optical fibres have an uncoloured outer coating.

5. Optical fibre core tape according to anyone of preceding claims, characterized in that at least one variation in the profile of the matrix cross-section is provided at the longitudinal split line.

6. Method of manufacturing the separable optical fibre core tape of claims 1 to 5, in particular of the type based upon acrylate cross-linking through UV irradiation, in which the tape matrix resin is applied by pressure through suitably calibrated dies designed to perform also the alignment of the tape structure and the formation of the profile thereof with the wished dimensions, characterized in that at least one high tensile strength thread-like separation element is applied in line to be embedded in said resin matrix and in that said at least one thread-like element is subjected to tensile stress with in line control of the latter.

7. Method according to claim 6, characterized in that said tensile stress which said at least one separation element is subjected to, is comprised preferably between 5 cN and 50 cN.

8. Optical fibre cable, in particular for use in telecommunication networks, comprising at least one separable optical fibre core tape of the type claimed in claims 1 to 5.

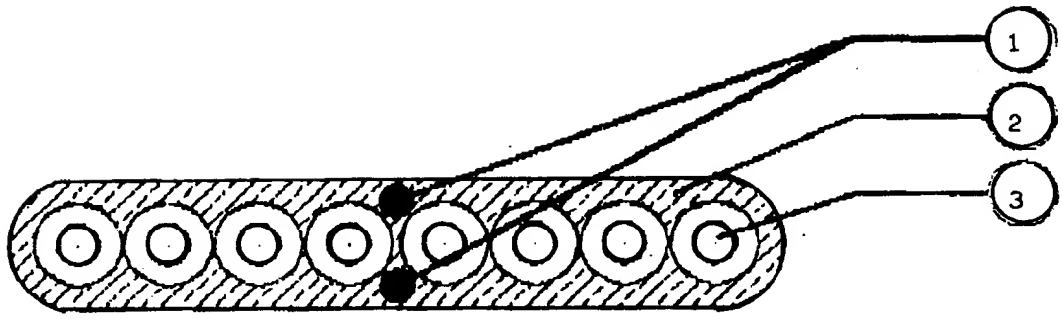

Fig. 1

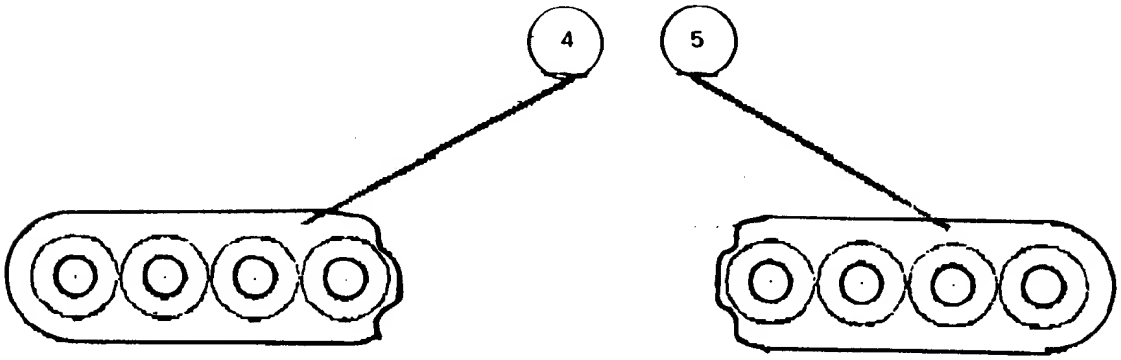

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 94 11 5901

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	DE-U-89 01 208 (KABELMETALL) * claims 1,4; figures * * page 5 *	1,4 2,3,6	G02B6/44
X	PATENT ABSTRACTS OF JAPAN vol. 13, no. 389 (P-925) 29 August 1989 & JP-A-01 137 209 (SUMITOMO) 30 May 1989 * abstract *	1,5	
A	EP-A-0 321 787 (SEL) * claims 5-7; figure 2 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 499 (P-807) 27 December 1988 & JP-A-63 208 814 (HITACHI) 30 August 1988 * abstract *	6	
A	US-A-4 720 165 (S.TOKUDA ET AL.) * claims 1,2 *	6	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	30 January 1995	Fuchs, R

CATEGORY OF CITED DOCUMENTS

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